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AUTHOR Umbach, Kenneth W.
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ABSTRACT

This paper presents ideas about what is required for the development of expertise in computer technology and considers those requirements in the K-12 setting. This analysis comes from the point of view of long-time, self-trained users of personal computers and computer communications and long-time observer of the growth of technology expertise in California State Government, but who are not in the K-12 system. The paper: (1) outlines hypothesis regarding acquisition of expertise ("no one becomes expert in the use of personal computers who does not own one and learn predominantly at home or otherwise on personal time"); (2) presents a revised view reflecting responses received by e-mail; (3) illustrates with examples; and (4) interprets the revised hypothesis in the light of a simplified view of the K-12 setting. References to "personal computers" or "computer technology" encompass various platforms, including the Macintosh and the Intel/Windows/IBM-compatible platform, and communications via local area networks and the Internet. (AEF)

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Computer Fluency: Teachers and the New Technology

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A discussion paper

Kenneth W. Umbach, Ph.D.

December 12, 1997

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

I believe if you sit at a computer 8 hours a day 5 days a week for at least 12 to 15 years you can become extremely efficient on a computer without owning one at home.

--A computer-proficient public school employee in Tampa, Florida

It probably takes longer to become competent without a home PC, but multitudes of underpaid South Dakota teachers are living proof that it can be done.

--A school librarian in South Dakota

Introduction

In only 20 years, microcomputers have gone from a hobbyists' toy to an everyday tool in business, education, and even home life. The last few years have seen explosive growth in the Internet and in its role in communications, commerce, and education. The rapid growth and development of this technology has challenged millions of people in many occupations to master often difficult tools and concepts, and will continue to do so as prices drop, power increases, and applications proliferate.

Many individuals have had to master the management and use of the technology and train others to make productive use of unfamiliar computer hardware, software, and communications tools. Much of the process of developing expertise has taken place at the initiative of individuals who have actively learned how to use hardware and software on their own time and using their own resources. To a large extent, especially in the first decade after the arrival of the IBM Personal Computer in 1981, learning to use computers was a by-your-own-bootstraps process in which people lifted themselves into competence and helped to embed the technology in the workplace.

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What are the necessary factors for the acquisition of expertise in computer technology? And how do those factors relate to the particular needs of kindergarten through 12th grade teachers and other staff and to the institutional setting of the school?

This discussion paper lays out some ideas about what is required for the development of expertise and to consider those requirements in the K-12 setting. This analysis comes from the point of view of a long-time, self-trained user of personal computers and computer communications and long-time observer of the growth of technology expertise in California State Government, but one who is *not* in the K-12 system. I have, however, been the beneficiary of comments and personal vignettes offered by many teachers and librarians, and others familiar with the K-12 setting.

This paper (1) outlines my original hypothesis regarding acquisition of expertise; (2) presents a revised view reflecting responses received by e-mail; (3) illustrates with examples; and (4) interprets the revised hypothesis in the light of (an admittedly simplified view of) the K-12 setting.

References to "personal computers" or "computer technology" encompass various platforms, including the Macintosh and the Intel/Windows/IBM-compatible platform, and communications via local area networks and the Internet.

The Original Hypothesis

In a nutshell, my starting hypothesis was that no one becomes expert in the use of personal computers who does not own one and learn predominantly at home or otherwise on personal time.

That is, it appeared that two circumstances were necessary (but might not be sufficient) for an individual to become expert in the use of personal computers:

1. That he or she own a personal computer.

2. That he or she learn to use the computer and software largely on personal time.

The individuals I had in mind when I posted this hypothesis for comment on education-related Internet mailing lists were employed adults (a point I did not note in the posting).

I considered these circumstances to be necessary because I believed that persons employed full time needed an opportunity away from the workplace to play with the machine, to experiment, to make mistakes out of sight of others. It also seemed generally unlikely that sufficient time or training would be available during work time to permit the development of expertise. Observation and personal experience have suggested the importance of unimpeded access to a personal computer and to the type of software one must use on the job in order to become fully conversant with the workings of both.

In my posted message, I asked list members for counter-examples--that is, to tell me about people who have learned the technology entirely on the job or through formal training, but without owning one of the machines.

I received responses from dozens of individuals, including teachers, library media specialists, and a few other people familiar with K-12 education. Needless to emphasize, the responses in no way constitute a scientific sample or a reliable cross-section of the population. However, the responses did include examples that contradicted my original hypothesis, although often in ways that suggested some needed refinements and extensions. Plainly, there *are* individuals who have attained expertise (without quibbling over the definition of the term) without owning a personal computer. Certain important characteristics seem to be common to those who shared that experience, and I have attempted to account for those characteristics in the next section.

Some respondents simply agreed with my original hypothesis and doubted that I would find counter-examples.

The Revised Hypothesis

Because I received several responses from people who had become expert with personal computers without owning one, personal ownership has to go out the window as a necessary condition. That does not mean personal ownership is not helpful, or that it is not very common among those who are expert with the technology. But it does demand reworking my original view. This is the revision (taking ability to learn, however, as a given):

> *The acquisition of expertise with personal computer technology requires all of the following: motivation, means, and opportunity.*
>
> *That is, the individual must have a compelling reason to learn (motivation), must have substantial access to the necessary tools, including hardware and software (means), and must have the time and ancillary resources, such as books, classes, tutorial programs, and so on (opportunity). None of these alone is a sufficient condition.*

Some degree of competence may well be developed by someone lacking one of these elements (especially motivation), but *expertise*, I believe, rests on the tripod of all three.

Ownership of a computer and appropriate software is a significant indicator of potential expertise because

- it is a likely indicator of motivation to learn and use the technology;
- it provides the means for acquiring and practicing skills; and

- it facilitates the needed opportunity, as it is available evenings and weekends.

Other things being equal (including motivation to learn), ownership of the computer and software multiplies opportunity, and for that reason alone may be a *significant* support (but of course not a sufficient condition) for the development of expertise.

However, it is plain that there are other ways of bringing together the three elements, as illustrated by several of my correspondents. The next section reports on the responses I received.

Examples

Dozens of people were kind enough to respond to the messages I posted on LM_NET and EDTECH. In this section, I present some of the experiences they reported, omitting names and identifying details, but quoting for illustration (sometimes with slight rewording for clarity and omissions for brevity). My apologies to those who would have preferred to be quoted by name; I felt it best to err on the side of confidentiality.

The responses are of course in no way a statistical sample of anything, as they were self-selected, comprised a relatively small number, and responded specifically to a request for examples disproving my hypothesis. Nonetheless, the people who responded encompassed a considerable variety of experience.

Some folks agreed

Several people wrote to agree specifically with my original view, in whole or in part:

- I will be astounded if anyone can provide information on someone who is an expert without a computer at home. Please post a HIT [a summary of responses to an inquiry on the LM_NET listserv] if you get any evidence that one can learn this all on the job . . . .

- I believe it is absolutely impossible to learn computer skills "on your own." I tried to learn while still working on an Apple IIe at home. There was not enough time at school along with sporadic "professional development" attempts . . . It had taken time to realize I needed my own computer at home, synthesize what I learned both on my own and with help . . . to finally arrive at a level to be "somewhat computer literate."

- I became skilled without owning a computer at home . . . [but] everyone else at my school became proficient only after they got one at home. [This person is also cited in the "some learned on the job" section, below.]

- I agree with your thesis that this is done on one's own time. In fact, I was unable to find the time or energy to do that and so have taken a leave of absence (unpaid) from my school district for this year to work on upgrading my computer competency.

- I totally agree that it will be on personal time. Also, there must be a need (or push, or incentive, etc.). I began when I entered a Master's program . . . and bought a computer . . . . As a result, I was the first librarian to automate in my district, the first to connect to the Internet. I doubt you'll find examples of the other side.

- When our school got Apple 2e's, we bought a 2c. When we got Macs, I lugged one home every weekend and vacation. When we got IBM's I bought a Gateway 2000. Without the 1-2 hours nightly and much more on weekends there is no way I could keep up with being a professional librarian and have any computer skills. Time to learn during my day? Ha---

- You know that answer before you begin. One has to have a machine to make mistakes -- or in other words, to learn. Realizing this, our school district arranged a computer buy . . . [and] financed it for the teachers, 10% down and the rest deducted from paychecks with no interest. . . . I see a real difference in the teachers who have computers at home and those who don't.

- Based on my experience, I think your hypothesis is correct. One does not have the time to become an "expert" computer user on school time alone. Even if training is provided, one must have time to apply it and a busy teacher just doesn't have the time at school. I think a school district which really wants to promote computer literacy in its staff will find a way to provide home computers at very reasonable prices . . . .

- I am afraid I cannot provide a counter-example for you, I am entirely self-taught on my home computer.

- Our . . . School District decided that the only way for staff to learn was to do it on their own computers and thereby their own time. So they bought laptop computers for every single teacher starting about 6 years ago. . . . It created a lot of controversy at the time, but I think the teachers have really latched on to and learned because of it.

- After reading your posting on EDTECH, I wanted to let you know that I agree with you wholeheartedly. I started out with a PCjr at home, where I merely typed in programs which I found in magazines such as *Compute* and *Family Computing*. . . . I devoted ENDLESS hours to

the pursuit of understanding and using computers because I knew that I couldn't possibly attain the knowledge which I desired without devoting a great deal of my own time. . . . I can't imagine how your research into this subject could possibly yield results other than those similar to mine.

- My experience in working with others has been similar to yours: those who have their own computers at home generally seem to pick up new computer skills faster, especially if the computer at home is the same vintage as the one at the office. [This comment was, however, offered by someone who learned computers without owning one himself.]

Some who wrote had free use of employer's PC at home

- I do not own a computer but am able to bring home a laptop and spend an inordinate amount of time at home working on applications and projects which interest me.

This is a category that comes fairly close to the category of computer owners. I suspect that some folks in that situation might well have found a way to purchase a machine had the employer not provided it, but that is speculation. In some cases, the home access provided by the employer may have been the needed extra incentive and opportunity to push on to expertise.

Some learned on the job

Some correspondents described how they had become proficient computer users and even managers or technicians on the job.

- About 3 years ago, I was given 4 computers, one to be a host and the other 3 to be workstations. When I say given, I mean that is in here they are in the box for you. . . . I not only had to use them, I had to physically put them together, as well as network them and get all the programs loaded on them. It seemed at times overwhelming, but very fascinating. It was a challenge. . . . I feel that I have learned on the job and in formal learning. I have gone back to school to earn my masters of ed with an emphasis in instructional technology.

- Eight years ago, I took the job as library paraprofessional at an elementary school library. Soon after I began I was asked to be the school's computer liaison to the district computer committee. I agreed, in spite of the fact the only computer I had ever used was in college -- this was a mainframe using keypunch cards. Three years later, when I left (still not owning my own computer at home), I had learned enough DOS, Windows, and Macintosh to keep the school's computers

running (for the most part). . . . I did everything from installing software to installing video cards, scsi cards, you name it, I did it. . . . So yes, it can be done.

- I am a relief librarian in the State Library and University system . . . . I went to a range of Adult Ed. classes about 4 years ago as computers were being introduced -- DOS/Windows/File Management. It was initially quite a steep learning curve, particularly as I couldn't practice between classes. . . . I had no other experience on computers (except for the library databases . . .). Nor did I have a computer at home. I read relevant magazines and practiced at lunchtimes, and am now regarded as extremely competent.

- I have never had one at home. But this has been my schedule since 1987: arrival at school 7:15; leave 5 or 5:30; spend part of every Sat. and Sun.; spend summers doing something from printing mailing labels to editing a library newsletter. I am convinced you must work at it to get the EUREKA sensation that pushes you to learn more. I agree with you that most of our learning is actually at our own expense.

- Today, I am a computer integration instructor, responsible for training teachers, assisting teachers with intensive technology curriculum plans, and otherwise supporting the use of technology in the classroom. Most of my experience came from using my computer at work. . . . I took every opportunity to go to conferences and workshops. Although if I couldn't apply this knowledge soon after, the workshop was fairly useless. . . . *I think in technology, being fearless and willing to try is a tremendous asset to learning new programs.* [Emphasis added.]

- I am currently employed as Automation Consultant for a regional library . . . . I worked as the system administrator and trainer for a software company for almost five years previous to the time I've worked here, and worked as an Automation Specialist for a different regional library system for several years before that. I have never in my life owned a computer of my own. . . . I have been lucky enough to work for folks who didn't mind me spending a few extra hours here and there figuring out how the computers work.

One correspondent is a classroom teacher with an unusual on-the-job learning situation:

- I became computer literate (able to use a Mac LCIII, printer, and word-processing program, as well as a hand scanner) on my classroom computer at school during the workday. However, I learned in conjunction with several eighth grade students who were also non-owners at the time. I had just become tech chairperson and was in

charge of setting up and maintaining 25 computers. The kids and I read the manuals and learned mostly by trial and error. These kids (5 years later) are seniors, editors of school papers and yearbooks and are proficient in desktop programs. (i am not.) While I learned the basics that year, I have at this point used much of my own time and do now have a computer. [Note: more than one teacher mentioned the enthusiasm and ability with which students pick up the technology.]

Another teacher learned in the school computer lab, but considers the circumstance unusual:

- I became skilled without owning a computer at home or having one in my classroom, but it required many hours of trial and error work on the computer labs in my school. I was the only one at school who would spend the time and keep the computers in the lab functioning. I agree with you though, that that was an unusual circumstance. Everyone else at my school became proficient only after they got one at home to use.

I received other notes from people who had learned on the job (or who knew or worked with others who had). In some cases, though, the learners clearly invested much of their own time taking classes and reading manuals and trade books, even when not owning a computer of their own.

Some learned in college

Learning computer technology in college can be expected to be an increasingly common pattern, as teachers enter the schools having already learned acquired skills in the course of their studies. As of the year 2000, California will require newly accredited teachers to have already acquired "basic competency in the use of computers in the classroom." (Chapter 404, Statutes of 1997, A.B. 1023, Assembly Member Mazzoni.)

- During my freshman and sophomore years in college, I became extremely proficient in using Macs only through using the ones in the computer lab. I learned word processing and desktop publishing before I bought my first Mac at the end of my sophomore year. . . . I logged a lot of hours in the computer lab doing layout for the college literary magazine. [Note: this is someone who will go into the workplace AS a computer owner and with established knowledge.]

- I think I might qualify as an example of someone who became proficient in using microcomputers without ever owning one. I was a computer-phobe before I started library school in September of 1994, and had only used a "non-computer" type word processor and a typewriter along with several brief and not very effective uses of computers for undergraduate classes I took. In Library school, I

> learned to use both PCs and Macs, CD-ROMs, OCLC, various word processing programs, spreadsheets, databases, Internet, e-mail, etc., without ever owning a computer. All my exposure came from waiting at the lab door before opening hours and taking my spot at the computer closest to the door to do my required classwork. . . . On the job [following graduation] I have learned to use and maintain an automated library system and have also served as a systems operator on our school network.

Implications for K-12 Education

The people who become expert with computers without owning one and learning at home have *access to the hardware and software on the job* (or in school, if they are students), *time to learn and practice*, and *resources for help*.

In many cases, these are people who have responsibility for putting computers to work, and who therefore *must* do whatever is necessary to learn on the job. In some cases, their responsibility extends to several or many computers, or even a local area network. In others, they are responsible for doing their own work on a single computer and must master several programs and learn to use the operating system and cope with minor hardware problems in order to do their own jobs. They may then increasingly serve as a resource to other users, in turn learning even more through informally teaching coworkers on the job.

In general, though, *classroom teachers do not have the time during their regular work hours to become highly skilled with computers* -- not in any broad sense. (This is a point that some correspondents made explicitly, but simple observation should be sufficient to prove in any event.) They may have the means (a computer and software, and even a network/Internet connection), but frequently not the opportunity during work hours no matter how highly motivated they may be. They have classes to teach, preparations to make, and other tasks that must be done during the day. They cannot close themselves in a room and play with the computer, try out software, look up answers in manuals, and call on experts for help, for the many hours needed to become what one commentor called "fluent computer users."

A number of people I have interviewed said that the skilled users among the teaching staff did have their own computers and put in much personal time to learn how to use them. In some cases, districts have provided computers for the teachers to take home, providing the same opportunity. Some districts (though none I know of in California) have provided or arranged for low-cost or interest-free financing for teachers to buy computers, but this is simply a means to encourage personal purchases.

The implication of all of this is that school districts must provide means and opportunity for teachers to become proficient with the technology they expect the teachers to use and that they anticipate students will be using in their classes. It is either that, or simply

mandate the learning and leave it up to the teachers to figure out how, an option that is not necessarily acceptable.

Computers are just *much more complex* than earlier technologies, such as VCRs and slide projectors, and require correspondingly more time and practice. They are even more complex to integrate into curriculum. The specific ways of providing the means and opportunity will have to be worked out locally, in cooperation with the teachers and the district's technical and administrative staff. It cannot be assumed that short-term workshops will be sufficient, as what is learned must be used in order to be retained.

Before concluding this section, I should mention the other factor that distinguishes K-12 from many other work environments, with respect to computer technology training needs. That factor is the additional layer of training (and experience) needed for teachers to *integrate the use of the new technology into curriculum*. It is not sufficient for a teacher to be competent in writing documents, sending e-mail, and finding information with a computer and network connection in isolation. Ultimately, the teacher will need to work these techniques into the normal course of classroom activities in as fluid and natural a manner as the teacher integrates books, lectures, one-on-one mentoring, and a host of other established methods into presenting information and interacting with students. Training in such curriculum integration is an additional task above and beyond training in how the hardware and software work.

I invite comments and recommendations regarding how districts can or should cope with training requirements.

- What are the *district's* responsibilities?
- What are the *teachers'* responsibilities?
- What are the roles and responsibilities of *technical and other support staff*?
- What methods may be most appropriate for providing access and opportunity?
- How and when should questions of curriculum integration and application of computer technology be addressed in formal training? (And as with more basic levels of training, who has what responsibilities?)

Some closing thoughts: constructing a framework for proficiency

I hope that educators will forgive me a side-trip into educational philosophy. I have pondered (and experienced) the role of hands-on learning of computer technology for years, and would like to try to fit the issue into the currently prominent "constructivist" perspective. I have a long-standing interest in self-directed learning as well as an inclination toward experiential learning, especially in the areas I write about. It seems to me that constructivism (at least what I have read of it) has much in common with notions of self-directed and experiential learning. Constructivism is controversial in some circles (consider the writings of E.D. Hirsch and Charles Sykes), but is accepted as a "given" in

others. Perhaps these comments might help to bridge that gap. What follows is basically the discussion above recast in different, but I think useful, terms

Constructivism maintains that knowledge is actively "constructed" in the mind of the learner, not passively received. For that reason, it is vital that the learner be engaged in a hands-on fashion in the learning of any subject. A contrasting view of education emphasizes the learner as receiving knowledge imparted by a teacher and by books, as a vessel to be filled with learning. The constructivist view sees the learner as actively engaging with tasks, from which knowledge may be built. (It is not clear that in practice the dichotomy has been so stark -- and both sides may have engaged in misrepresentation and name-calling -- but that is a discussion for another time.)

Without getting into a debate over the merits of these contrasting views (or even trying to explicate them), I'd like to outline how I see the process of acquiring fluency in the use of computer technology, and see what comes of that. The question is, do adults who must learn to use computers construct their knowledge? If so how?

For most people (maybe for all), computers *are not intuitive*. In contrast, a typewriter is (at least relatively) intuitive. We are used to writing words -- we see them immediately appear on paper. When using a typewriter, we likewise see the words appear immediately on the paper. Write a letter, see it. The pen impacts the paper. Type a letter, see it. The finger impacts a key, with the immediate result of an impact on the paper producing the corresponding letter. (Learning the keyboard layout may be a nuisance, but that is not the issue here.) There is a reasonable analogy between pen-words-paper and typewriter-words-paper.

A word processing program, though -- now that is an entirely different animal. First, you have to *get to* the word processing program, and that may require many steps. (It may even require the user to install the program from disk(s), itself a complicated and completely new idea to the novice.) The user faces complicated menus, icons, symbols ... and a blank area on the screen. Yes, pressing keys makes words appear ... but not on paper. An intermediate step has been introduced. First the words go to the screen ... and then, if all goes well, to paper. The paper may be loaded into a printer across the room (or in another room entirely!) The sense of immediacy is lost.

The words may be lost, too, if the file is not saved. This is yet another entirely new concept: the computer file. The role of the computer mouse, a new and strange device at first, further confuses matters.

Now consider the multitude of other programs -- spreadsheets, graphics, communications, database -- each with its own unclear analogies to familiar paper-based methods -- or, in the case of communications, telephone, television, and radio in addition to letters and memos on paper. *(Have you ever tried to explain a relational database management system to someone who has only used file cards and manila folders to manage data?)*

Not only does each of these types of program present its own difficulties, connecting one to another is *yet another* series of concepts and techniques to be learned.

I have not yet mentioned operating systems, or macros, or managing and navigating directories on hard disks and floppy disks (not to mention the complexities presented by disks in the first place!), or graphical interfaces, desktops, multitasking, the conventions of naming files, the importance and methods of backups. These, by the way, are all typical end-user tasks and concepts! I am not even *alluding* to the more technical demands that may be placed on computer support staff -- troubleshooting balky display adapters, configuring networks, installing software upgrades, defragmenting hard disks, and on and on.

The fluent computer user, the one who can sit down at a computer and successfully use a variety of software and the various input and output devices in a coherent fashion for typical end-user tasks, coping with typical problems along the way, *has learned a lot* to get to that point.

Well, there is no way that fluent users became such by listening to abstract talks about word processing, the Windows operating system, or how to connect the parts of a PC. Nor is it sufficient to read manuals or trade books that document and explain the software and hardware. Hearing explanations may be helpful, and manuals and books can be wonderful resources, **but the user has to have a conceptual framework**. And indeed, the user constructs that framework by using a computer and software -- by trying things out, seeing the results, and probably making a lot of mistakes along the way *and* asking a lot of questions. As the framework is built it becomes easier and easier to hang new pieces of knowledge -- even entire new concepts -- on that framework, or if you prefer, to fit the pieces into slots and cubbyholes. It also becomes increasingly possible to know what the right *questions* are. Once the framework is in place, constructed from the materials of experience, new information read in a book or heard from an instructor stands a much better chance of fitting in to the reader/hearer's existing knowledge.

You cannot become an expert driver without driving, an expert golfer without golfing, an expert writer without writing, or an expert computer user without computing. That does *not* mean that you have to reinvent every great idea in the history of driving, golfing, writing, or computing yourself! But it does mean that you need a framework, constructed ultimately through hands-on activity, that enables you to make sense of knowledge received through other means (from speakers, books, videos ... or whatever).

In a nutshell, to become skilled with computers, you have to get your hands on one long enough and with the necessary resources to learn important concepts from the ground up.

Unfortunately, computers have an unforgiving way of making novices feel stupid. (That may be one reason for the success of books with titles like *The Complete Idiot's Guide to Microsoft Word* and *Windows 3.1 for Dummies*.) There is so much to learn, and so many

ways things may not work, that it can be acutely uncomfortable for many people to learn where others can watch -- especially for adults who are accustomed to being and feeling competent in their own areas. Suddenly this dratted machine is beeping, eating files, and producing unintended mish-moshes -- and all the while the novice is concerned that pressing the wrong keys will damage the machine. This is why some degree of privacy may be valuable while learning. (It does not help that 10-year-olds seem to have mastered such arcana already.)

All of this really brings us back to my earlier point: to become proficient, one who learns to use computers needs the motivation to overcome the difficulties and to stay the course, access to a computer (with appropriate software and peripherals) on which to learn, and time to figure things out and a way to get help with specific problems or with grasping principles. None of this means that hearing explanations is not valuable, or that reading books about, say, Excel or Netscape, is not helpful. All it means is that hearing and reading alone are just not enough.

In other words, if a constructivist approach to educating children makes sense, the same approach makes just as much sense in teaching teachers a new technology. That has implications for how technology is introduced into the schools and for the level of expectations that may be reasonable during a (possibly somewhat lengthy) process of introduction. Workshops are fine, but there will be no substitute for extended hands-on opportunity to learn. Some will provide that opportunity themselves by buying a computer and learning on their own time. Others (perhaps less motivated or less financially able) will need for that opportunity to be well orchestrated by the employer. And one size does not fit all.

To those who have made it this far, thanks for your time and interest! I'll look forward to hearing from you. E-mail me at kumbach@unlimited.net or kumbach@library.ca.gov. If you prefer, mail comments to Ken Umbach, California Research Bureau, 900 N Street, Sacramento, CA 95814.

A special thanks to all those who took the time and effort to reply to my posted inquiries. Your assistance was of enormous value. Gloria Pearce deserves particular acknowledgement for suggesting the resonant terminology of "computer fluency" and the "fluent user." The term was so fitting that I put it right in the title.

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